The Automated Interview versus the Personal Interview

Do Patient Responses to Preoperative Health Questions Differ?

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Laboratory testing of presurgical patients has been shown to be excessive, thereby increasing costs, reducing resources for other health care uses, and increasing risks to both patients and physicians. As one step toward reducing the number of unnecessary preoperative tests ordered, we used an automated method to aid preoperative assessment of 239 patients in Chicago and in Winnipeg. The "HealthQuiz," a small hand-held device containing a computer chip and video screen, uses a decision tree to ask a minimum of 60 health-related questions (the patient's response to certain questions determines the number of questions presented). The device then generates a summary printout of patient answers, the health areas needing further attention, and the laboratory tests most likely to uncover clinically important abnormalities in that patient. HealthQuiz responses are intended to aid the physician and not to replace the personal interview. As an aid, the automated interview highlights possible problem areas for in-depth pursuit by the physician. The need for nonselective batteries of tests is eliminated because recommendations for tests are based on specific elements of a patient's history. To be effective, responses to the HealthQuiz should be the same as responses to similar questions asked by a physician. We tested that premise in this study. Patients' answers to the HealthQuiz were compared with their responses to a randomly selected set of the same questions in a personal interview. Ninety-seven percent of the response pairs were identical, and most of the 3% that differed involved changes from "not sure" replies to the HealthQuiz. Laboratory tests suggested by responses to the two methods of questioning did not differ. We conclude that an automated system for obtaining health histories and selecting laboratory tests could be used by most patients who read English, and that patients from differing socioeconomic backgrounds would respond similarly to both video and oral presentation of questions. (Key words: Anesthesia: preoperative evaluation. Equipment: computers. Records, medical: automation. Testing: preoperative.)

APPROXIMATELY 50–70% of preoperative laboratory testing could be eliminated without adversely affecting patient care.[1-9,a] This unnecessary testing tends to increase risk to the patient,[9-12] inefficiency of operating room schedules,[13] and costs.[14,15] Such testing may be hazardous to patients because of the pursuit and treatment of the 30–70% of borderline positive results and false-positive results. In addition, extra testing may increase medicolegal risk for the physician, as newly discovered abnormalities are not noted in the patient's medical record by the physicians caring for the patient.[4,16-29] Blue Cross/Blue Shield estimates that the cost of preoperative testing and evaluation in the United States was $30 billion in 1984, and that $12–18 billion could have been saved if only the appropriate tests, i.e., those indicated by the patient's history and benefit–risk ratio, had been performed.[b]

Studies have shown that selective preoperative laboratory testing based on a patient's medical history detects virtually all of the clinically important abnormalities revealed by screening tests. An abnormality is considered clinically important if its discovery can ultimately benefit the patient.[1-5,7,9,30,c] As a result, many medical societies and national organizations have endorsed the concept of obtaining preoperatively only tests that seem warranted by a patient's clinical condition.[d]

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ª Roizen MF, Kaplan EB, Sheiner LB, Cohen SN, Ehrenfeld WK, Stoney RJ, Dedo HH: Elimination of unnecessary laboratory tests by preoperative questionnaire (abstract). ANESTHESIOLOGY 61:A455, 1984

ᵇ As reported in the press at the time of release of the Blue Cross/Blue Shield Medical Necessity Guidelines. For example, see Are We Hooked on Tests? U.S. News & World Report, Nov. 23, 1987, pp 60–66.

ᶜ Kaplan EB, Boeckmann AS, Roizen MF, Sheiner LB: Elimination of unnecessary preoperative laboratory tests (abstract). ANESTHESIOLOGY 57:A445, 1982

ᵈ Medical societies include the American College of Surgeons, the American Society of Anesthesiologists, the American College of Physicians (Clinical Efficacy Project), the American Academy of Pediatrics, and the American Society of Radiologists. National organizations include the Food and Drug Administration's panel on presurgical chest x-rays, the National Institutes of Health Consensus Panel on Anesthesia and Sedation in the Dental Office, and the Blue Cross/Blue Shield Medical Necessity Panel.

Nevertheless, no easy method has been available to select tests based on patient history. Our early efforts first with paper-and-pencil and later with computer questionnaires were not completely successful: physicians and nurses found the first process tedious, and some patients were intimidated by the computer. We subsequently developed an automated method, HealthQuiz, relying on a small computer device guided by a preprogrammed algorithm.[e] Patients seemed to enjoy using this device; preliminary tests indicated that the HealthQuiz is successful in reducing inappropriate testing.[30] However, we were concerned that patients' answers to questions presented on a video device might differ in some systematic way from answers they would have given in a personal interview, the usual method of eliciting a patient's history.

The current study investigated the hypotheses that patients would respond identically both to automated video presentation of questions and to oral presentation during an interview, and that an automated format for the presentation of health questions could be used for preoperative evaluation of most patients who read English.

Materials and Methods

We obtained institutional approval and informed consent to study patients at two preoperative anesthesia clinics, one in Chicago and one in Winnipeg. Patients at both clinics were from diverse cultural and socioeconomic backgrounds. Two hundred and sixty-two patients of age 9 yr and older were approached, and 250 stated they could read English.

THE HEALTHQUIZ

Patients were given the HealthQuiz, a small, portable box that contains a computer chip and a video screen. Using a decision tree, the HealthQuiz presents 60–120 health questions to each patient. Responses to certain questions determine the direction of questioning and the number and order of subsequent questions asked of each patient. HealthQuiz contains 134 questions, although most patients answer fewer; the maximum possible number of questions is 120 for women and 114 for men. Patients respond to each question by pressing one of three buttons, "yes," "no," or "not sure." After answering a question, they press a "Go to the next question" button to continue.

A preprogrammed algorithm based on predetermined criteria guides the HealthQuiz in identifying potential health problems and suggesting appropriate tests for detecting those problems. For example, a history of a bleeding diathesis indicates the need for a bleeding time, a platelet count, and determination of prothrombin and partial thromboplastin times; a history of active lung diseases indicates the need for chest x-ray.[8,31,f]

To improve the accuracy of responses, the HealthQuiz seeks information about an important physical condition at several points in the process and checks all responses regarding that particular subject against one another. Thus, the HealthQuiz has several opportunities to identify clinically important problems. When responses to similar questions are inconsistent, the HealthQuiz highlights the inconsistencies on a printout for the physician. It flags the top of the HealthQuiz report and tells the physician to disregard all answers to the HealthQuiz. Such an admonition is printed in bold letters if the patient answered "no" to the automated question, "Did you understand all of the HealthQuiz questions?"

After the patient completes the questionnaire, the HealthQuiz is connected to a printer, which generates a transcript of both the questions and responses for the patient's review and signature. A list of indicated laboratory tests is also generated. Finally, areas that might need exploration in greater detail, such as allergies or familial problems with anesthesia, are summarized for the physician.

THE INTERVIEW

Ten minutes or more (usually 30–40 min) after completion of the HealthQuiz, patients again were asked a subset of ten questions from the HealthQuiz in a standard interview format. Questions were selected randomly for each patient from the list of 134 possible questions on the HealthQuiz. The wording of questions was identical to the wording used in the HealthQuiz. During the personal interview, however, the patient was permitted to seek clarification of questions. Without knowing the patient's answers in the HealthQuiz, the trained interviewer wrote down the patient's response to each question as "yes," "no," or "not sure." The interviewer often sought clarification of responses to determine accurately whether a patient's response was "yes," "no," or "not sure." All responses obtained by the interviewer that were not definitely "yes," "no," or "not sure" were recorded and reviewed by a physician before response pairs were com-

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[f] Roizen MF, Kaplan EB, Sheiner LB, Cohen SN, Ehrenfeld WK, Stoney RJ, Dedo HH: Elimination of unnecessary laboratory tests by preoperative questionnaire (abstract). ANESTHESIOLOGY 61:A455, 1984.

pared. (After the review, no response was altered from that indicated by the trained interviewer.)

COMPARISON OF RESPONSE PAIRS

Responses to the HealthQuiz were compared with responses obtained by interview: response pairs were either identical or different. Different response pairs were divided further, into contradictory—a "yes" followed by a "no" or *vice versa*—and not contradictory—a "not sure" followed by a "yes" or a "no" or *vice versa*. Different response pairs also were reviewed to determine if tests ordered would have differed after the HealthQuiz or personal interview. In the HealthQuiz, 80% of the questions that might indicate the need for a test require a "yes" or "not sure" response to do so, and 20% require a "no" or "not sure" response. The paired binomial procedure was used for statistical comparison of response pairs, and Fisher's Exact Test was used to compare responses among age groups.

Results

The printouts of seven patients (2.9%) with inconsistent answers on the HealthQuiz and of four patients (1.7%) who responded "not sure" to the question, "Did you understand all the HealthQuiz questions?" were flagged. The responses of these patients were analyzed separately from those of other patients (table 1) and showed an 8% contradiction rate (table 2). This rate of different responses was significantly greater than that of the rest of the patients (1.3%; see below). Results of the nonflagged and flagged printouts are combined in table 3. Inclusion of the responses of these 11 patients increased the contradictory response pair rate from 1.3 to 1.5% (see below). However, since the HealthQuiz reminded the physician to disregard the printouts of these 11 patients as unreliable, their responses were excluded from further analysis.

Therefore, the net sample size was 239 patients. One hundred sixty-nine patients were less than 60 yr of age; 53 were 60–74 yr of age; and 17 were 75 yr of age or older. No patient refused to participate in either the HealthQuiz, which took 4–30 min (a median time of 8

TABLE 2. Comparison of Responses by Patients Whose Printouts Were Flagged

By HealthQuiz	By Interviewer		
	Yes	No	Not Sure
Yes	13	3	0
No	2	35	1
Not sure	2	3	1

Printouts were flagged with the words "To the physician—This patient's responses are inconsistent or he/she indicated that he/she did not understand the HealthQuiz questions. Please disregard the HealthQuiz printouts."

min and 12 s) to complete, or the interview, which took less than 10 min to complete. Patients were asked to read the printout to verify their responses. Many patients, however, signed the printout without rereading the questions and responses. Excluded from calculation of agreement were 328 questions that appeared on the randomly selected interview lists but that were inappropriate for the respondent and therefore had not been asked in the HealthQuiz. For example, men were not asked, "Is there any possibility you may be pregnant?" in the HealthQuiz, but this question did appear among the randomly selected interview questions for men.

Of the 2,023 responses to questions obtained, 1,963 (97%) were identical for both methods of questioning (table 1). We do not know what the error rates would be for responses to HealthQuiz *versus* responses to a second administration of HealthQuiz or for responses to the interview *versus* responses to a second interview. Thus, the rate of error that would have occurred with a second questioning by the same method is included in the total error rate comparison between the two formats, *i.e.*, in the comparison between HealthQuiz and personal interview.

DIFFERENT RESPONSE PAIRS

Comparison of answers from the two formats produced 60 with discrepant responses, representing an error rate of 3.0% (table 1). Of these, 1 (0.05%) would have led to a change in the laboratory tests ordered. In this instance,

TABLE 1. Comparison of Responses Given to HealthQuiz with Responses Given during a Personal Interview

By HealthQuiz	By Interviewer		
	Yes	No	Not Sure
Yes	432	14	3
No	13	1,523	4
Not sure	9	17	8

Numbers exclude responses by patients whose printouts were flagged.

TABLE 3. Comparison of Responses Given to HealthQuiz with Responses Given during a Personal Interview

By HealthQuiz	By Interviewer		
	Yes	No	Not Sure
Yes	445	17	3
No	15	1,558	5
Not sure	11	20	9

Numbers include reponses of patients who gave inconsistent answers to HealthQuiz or who answered "no" to the question "Did you understand the HealthQuiz questions?"

the patient responded to the question, "Have you had a blood transfusion since 1979?" with "no" on the HealthQuiz and "not sure" in the interview. The interview suggested a test for human immunodeficiency virus (HIV), whereas the HealthQuiz did not. No actual change in care occurred, however, since HIV tests were not being ordered for patients in these two anesthesia preoperative clinics.

Of the 60 different response pairs, the most common involved changes to and from "not sure" responses. Discrepancies of this type accounted for 55% (33 of 60) of all differences and 1.6% of the total responses. In contrast, contradictory response pairs, e.g., a "yes" on the HealthQuiz followed by a "no" during interview, accounted for 45% (27 of 60) of the differences and 1.3% of the total responses. In the 14 instances in which patients responded "yes" on the HealthQuiz but "no" during interview, the HealthQuiz would have ordered more tests than necessary, if we assume the interview response was correct. In the 13 instances in which patients responded "no" to the HealthQuiz but "yes" during interview (0.64% of total responses), the personal interview would have suggested laboratory tests not suggested by the HealthQuiz. Because the HealthQuiz contains more than one question pertinent to each laboratory test, only in the instance described above (the HIV test) did the HealthQuiz actually not suggest a preoperative test suggested by the patient's interview response.

No individual question repeatedly elicited responses that differed between the HealthQuiz and interview formats, and no particular subject matter was more likely to produce different responses to questions in the HealthQuiz or in the interview. The 60 response pairs that differed represented 46 questions from the HealthQuiz. Ten questions evoked two instances of different response pairs. Two questions, "Have you or any blood relative ever had any problems with anesthesia?" and "Do you have heart problems such as skipped heart beats, angina, or chest pain?" evoked three instances of different response pairs. (All three patients responded to the anesthesia question with "not sure" on the HealthQuiz but "no" during interview. To the question about heart problems, the three patients responded "not sure" and

"no," "not sure" and "yes," and "yes" and "no," on the HealthQuiz and during the interview, respectively.) Regarding questions that evoked different response pairs from more than one patient, in two instances the pattern of difference was the same. Thus, the differences in response appeared to be random and not related to the question itself.

EFFECT OF AGE

The incidence of discrepant responses, both contradictory and not contradictory, increased with patient age (one-sided $P = 0.028$, table 4). Nineteen percent of patients younger than 60 yr of age (32 of 169) and 31% of patients 60 yr of age or older (22 of 70) responded differently to one or more questions the second time they were asked these questions. We did not test the reliability of answers in patients younger than 9 yr of age, and not enough patients between 9 and 18 yr of age were tested to determine if reliability in this age range is different from that of the group between 18 and 60 yr of age. Of responses from patients 60 yr of age or older, 32% of these responses (7 of 22) involved a "yes" to the HealthQuiz followed by a "no" during interview, and 23% (5 of 22) involved a "no" to the HealthQuiz followed by a "yes" during interview. Forty-six percent of the differences in this age group involved "not sure" responses that changed to definite answers during interview. In one instance, "no" on the HealthQuiz became a "not sure" during interview. Among patients 75 yr of age or older, 41% (7 of 17) responded differently to one or more questions (7 patients and 8 questions) the second time the same questions were presented. Sixty-three percent of the differences involved "not sure" responses that became definite answers during the interview; 37% involved a "yes" on the HealthQuiz that changed to "no" during the interview.

The type of "error" made by patients appears random with respect to age. Most different response pairs involving "not sure" answers were given by patients younger than 60 yr or 75 yr or older. Contradictory responses—a "yes" that changed to a "no" or vice versa between formats—did not differ between age groups, perhaps because of

TABLE 4. Age of Patients Who Gave Discrepant Responses to the Same Question

Age (yr)	Number of Patients	Number of Questions Asked	Questions With Different (but Not Contradictory) Responses		Questions with Contradictory Responses		Questions Resulting in a Change in Care	
			Number	%	Number	%	Number	%
<60	169	1,428	23	1.6	15	1.1	1	0.07
60–74	53	451	5	1.1	9	2.0	0	0
≥75	17	144	5	3.5	3	2.1	0	0
Total	239	2,023	33	1.6	27	1.3	1	0.05

the small sample of individuals older than 60 yr. The higher frequency of response differences for the patients 75 yr of age or older reflects a higher number of "not sure" answers on the HealthQuiz followed by "no" during interview, rather than an higher number of contradictory responses.

Discussion

DEVELOPMENT OF THE HEALTHQUIZ

The first method used by our group for eliminating unnecessary and selecting clinically important laboratory tests for preoperative assessment consisted of a paper-and-pencil health questionnaire.[8,a] The patient completed one questionnaire, and the surgeon or surgeon's secretary or nurse completed a second questionnaire. Clinically important abnormalities discovered by the tests ordered based on responses to these questionnaires were compared with those discovered by the tests ordered by the surgeon and/or anesthesiologist using his or her usual method of ordering preoperative laboratory tests. The study concluded that the patient questionnaire was significantly more sensitive and specific than the usual method of choosing preoperative laboratory tests.[8,a]

The cost effectiveness of the questionnaire method was limited, however, by the need for a health professional to assist in interpreting results. Furthermore, many physicians and their nurses or secretaries were reluctant to use plastic overlays or computer programs to correlate patient responses with predetermined criteria for test-ordering. Between 3 and 15 min per patient was required for this process, and the task was perceived as burdensome. Thus, the usefulness of the paper-and-pencil questionnaire was compromised by increased cost and inconvenience. To avoid these problems, our group, using the questions and test indications established in the previous study as a foundation, designed an automated system.

The initial attempt at automation used a Macintosh computer and a preprogrammed algorithm to apply decision rules to all patient responses. However, many patients (especially older ones) were intimidated by the computer. Some became apprehensive when requested to touch the computer screen or to use a "mouse" device to answer health questions. Therefore, we sought to develop a nonthreatening, portable, battery-powered computer device.

The previously used questionnaire, originally 45 questions, was expanded to 51 questions to include areas suggested by experts recruited to review pertinent abstracts and publications and was modified in response to comments made by these reviewers. The 51 questions and decision rules were published,[8,31] used to assess patients, and again amended according to 200 comments received from readers of the published version. Finally, the health

questions were put into lay language and into logically coherent sets preceded by introductory screens.

The HealthQuiz algorithm that selects laboratory tests is based on expert opinion and has been refined over the last 10 yr. The decision tree and questions have been modified further to conform to the recommendations of the following: the United States Food and Drug Administration's panel on presurgical chest x-ray testing, the Canadian Task Force on the Periodic Health Examination,[32] the American College of Physicians Clinical Efficacy Assessment Project regarding diagnostic tests and procedures,[33] the Blue Cross/Blue Shield Medical Necessity Panels,[g] and the United States Preventive Services Task Force.[h] A consensus on those recommendations was reached.[34]

Previous studies seemed to indicate that the rate of discrepancies in response pairs for automated *versus* oral presentation of questions would be low.[35,36,i,j,k] These studies used a computer-assisted format to present questions and then compared responses with those obtained by conventional personal interview. Response pairs were similar. Furthermore, these studies involved computers that were more complex to operate than the HealthQuiz device. Because participants responded accurately to these more difficult systems, it seemed reasonable to expect that our error rate with the easier-to-use HealthQuiz device would be as low or lower. Agreement between the answers to computer and oral questioning does not ensure reliability, since there is an unknown but real possibility that patients were able to recall the answers they gave to the first set of questions. Ideally, the second set of questions should have been asked after a longer time period had elapsed than we allowed in the current study. However, this bias toward consistency may be offset or even overwhelmed by an opposite bias, that of wishing to correct misinformation given in the first interview. We intend to study these effects further to see if either is significant.

POSSIBLE CAUSES OF DISCREPANCIES IN RESPONSE PAIRS

An examination of the discrepancies in responses for the two formats suggests that factors other than format

[g] Blue Cross/Blue Shield Association: Medical Necessity Program Manual. Chicago, Blue Cross/Blue Shield Association, 1987.

[h] United States Preventive Services Task Force (Lawrence RS, chair): Guide to Clinical Preventive Services. Washington, DC, Williams and Wilkins, 1989.

[i] O'Brien T, Dugdale V: Questionnaire administration by computer. Journal of the Market Research Society 20:228–237, 1978.

[j] Liefeld J: Response effects in computer-administered questioning. Journal of Marketing Research 25:405–409, 1988.

[k] Erdman H, Klein MH, Greist JH: The reliability of a computer interview for drug use/abuse information. Behavior Research Methods and Instrumentation 15:66–68, 1983.

may have been responsible. The most typical discrepancy consisted of a "not sure" on the HealthQuiz followed by a "yes" or "no" during interview. Perhaps the fact that the oral interview followed the HealthQuiz allowed patients more time to evaluate a question about which they had at first been "not sure." After completing the HealthQuiz, patients were given an opportunity to read a printout of both the questions and their responses. It is possible that when a question was posed for the third time, during the interview, the patient had reached a definite answer in the interval and was no longer "not sure."

This explanation is consistent with the observation that answers to questions requiring a patient to place a symptom or physical condition within some time frame (*e.g.*, last 2 weeks, last 6 months, last 2 yr) produced a high frequency of contradictory response pairs. In the 27 instances in which the interview response contradicted the HealthQuiz response, 14 questions had required the patient to think in terms of a specific time frame. For 8 of these questions, patients responded "yes" to the HealthQuiz but "no" during interview. For the other 6 time-frame questions, the patients responded "no" to the HealthQuiz but "yes" during the interview. The HealthQuiz question may have cued patients to the question subject, enabling a "yes" or "no" response the second time the question was asked. Had the interview preceded the HealthQuiz, the response during the interview might have been "not sure," since the interview would have been the patient's first exposure to the question. Of the 33 questions given a "not sure" response in one format and a definite answer in the other, 26 "not sure" responses were given to a HealthQuiz question. This figure is significantly ($P < 0.001$) greater than the 16.5 "not sure" responses one would expect if there were no recall effect (that is, if the 33 responses were distributed equally at the two different times of interview).

Another source of discrepancy in response pairs involves interpretation, both by the interviewer and the patient. During the interview, when patients answered a question with a long and involved explanation, the interviewer had to convert this response to a "yes," "no," or "not sure." Responding to HealthQuiz, the patient also interprets. The patient may have answered the HealthQuiz questions based on his or her view of the significance, rather than the mere occurrence, of a symptom. For example, to the HealthQuiz question, "Do you have, or have you ever had, low back pain?" a patient may respond "no" even though he or she recalls an isolated incident of back pain. In the interview, the patient's "no" response to the same question, followed by a description of an isolated incident of back pain, may cause the interviewer to write "yes" as the proper response to this question. Likewise, an interviewer's own attitudes may influence the data collected in an interview situation.[35] In ad-

dition, some of the responses during interview may have differed because patients did not wish to detain the interviewer. In our study, it seemed to one interviewer (REL) that a patient did not want to detain the interviewer by giving the long explanation necessary for the "yes" answer and therefore simply said "no."

For certain questions, patients may have been less inhibited with the HealthQuiz than with an interviewer. One interviewer (REL) believes that patients found the HealthQuiz preferable to the interview for questions regarding sex or acquired immunodeficiency syndrome (AIDS). Some patients may have responded more honestly to the HealthQuiz when asked questions of a sensitive nature. Earlier studies support this conclusion.[j,k]

THE ORDERING OF PREOPERATIVE LABORATORY TESTS

The HealthQuiz algorithm treats responses of "not sure" as "abnormal" or "triggering" answers. Thus, a "not sure" followed by a "yes" during the interview did not result in a difference in the laboratory tests suggested by the two formats. A "not sure" on the HealthQuiz followed by a "no" during the interview would have led the HealthQuiz to err on the side of ordering more laboratory tests than actually necessary. However, no such effect occurred: in every instance of this pattern, responses to other questions triggered the additional laboratory tests.

FURTHER STUDIES

This part of the evaluation of a portable-device computer-based questionnaire for preoperative assessment addresses the consistency of responses when patients answer the same question presented first by computer and then by a person. Results have indicated consistency of response to the two questioning systems and no systematic change in answers caused by either method of questioning. What has not yet been formally evaluated is the utility of the computer-based questioning. Do problems occur during surgery that might have been predicted based on preoperative information not flagged by HealthQuiz? Do patients prefer HealthQuiz and physician interview to preoperative evaluation conducted only with a physician? How much (if any) time is saved by using HealthQuiz? How much money is saved and how much harm avoided by eliminating unnecessary laboratory testing? These currently are unanswered questions.

Results from this study suggest that the HealthQuiz is as effective a method of obtaining patient information as is the oral interview. Questioning patients with the HealthQuiz led to ordering of the same laboratory tests as did questioning in an interview. In no instance was the difference in response for the two methods significant to patient care. Other researchers have found computer-ad-

ministered questionnaires as accurate and more thorough than conventional interviewing.[36,37,k] We conclude that an automated system for taking health histories and suggesting laboratory tests (the HealthQuiz) can be used by the vast majority of patients who read English and by patients from diverse socioeconomic backgrounds, making the physician interview that follows more thorough and perhaps more efficient.

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